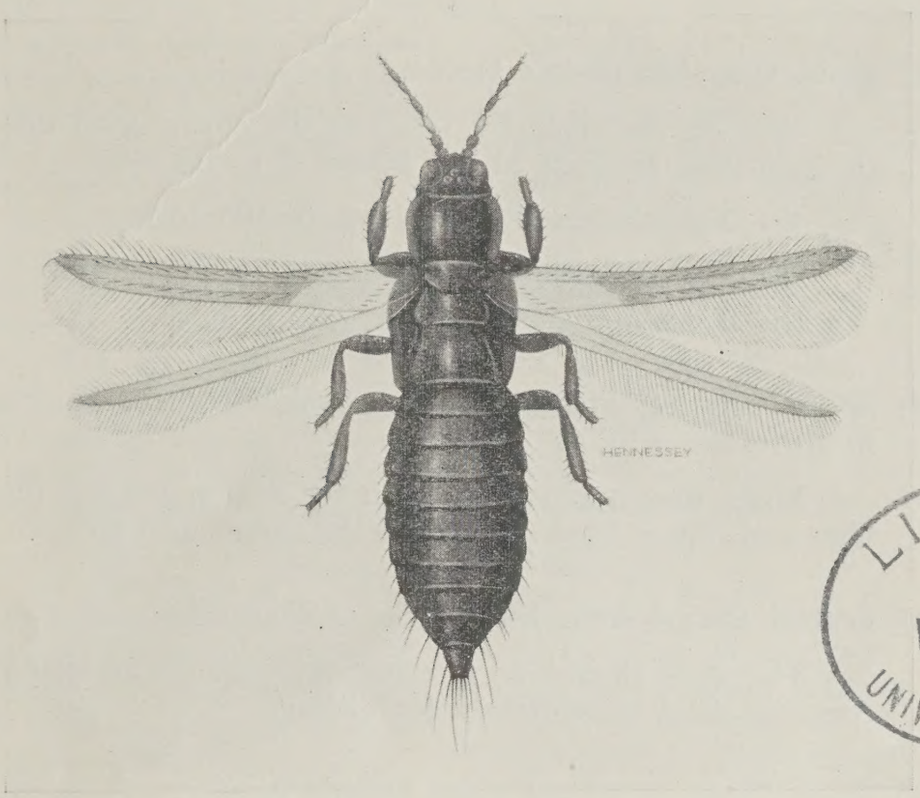
THE GLADIOLUS THRIPS

By ALAN G. DUSTAN



Gladiolus thrips adult; greatly magnified (original).

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SUMMARY OF CONTROL FOR THE GLADIOLUS THRIPS

(1) Plant Only Thrips-free Corms.

This can be done by treating the corms with one of the following methods in the winter or spring:—

(*a*) Naphthalene flakes—1 oz. to 100 corms.

(*b*) Corrosive sublimate—1 oz. to 6 gals. water.

(*c*) Hot water—120° F. for ten minutes.

(2) Spray Growing Plants with the Paris Green-Brown Sugar Mixture.

Make first application when the plants are 5-6 inches high and repeat weekly until the blossoms start to open.

(3) Protect Corms from Infestation at Harvest.

The tops should be cut low and the corms removed from the field immediately for drying.

(4) Store Corms in a Cool Place During Winter.

Storage temperatures should not rise above 40° F.

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THE GLADIOLUS THRIPS

By Alan G. Dustan, *Entomologist*

Introduction

The gladiolus thrips (*Taeniothrips gladioli* M. and S.) is a comparatively new pest in Canada, having been noticed for the first time in 1930. It is the most outstanding insect attacking gladioli known and is seriously threatening the growth and production of this popular flower. It is widely distributed in Canada and the United States and rapidly spreading into uninfested territory.

The insect attacks all parts of the gladiolus plant, but its work is more noticeable and injurious on the bloom, which is frequently totally destroyed. Injury to the leaves and corms is common and in the case of heavy infestations these parts also are seriously affected.

The thrips is known to pass the winter on the corms in storage but, as yet, has not been found hibernating successfully out of doors. All stages of the insect may be killed by treating the corms prior to planting. Fumigating the corms with naphthalene flakes or immersing them in a solution of corrosive sublimate or hot water has given the best results. The spraying of growing plants with a Paris green-brown sugar solution is also very effective.

In this revised edition of the pamphlet, information regarding certain phases of the biology of the insect has been supplied by two officers of the entomological Branch, Mr. P. I. Bryce of Vineland Station, Ont., and Mr. R. Glendenning of Agassiz, B.C. The growers themselves, through their helpful suggestions, have added very considerably to our knowledge regarding both the effectiveness and shortcomings of the remedies originally worked out as a result of which certain changes and modifications in control recommendations are made.

History and Importance

The gladiolus thrips is a new pest to North America, having first come to the attention of gladiolus growers in Canada in 1930, when a very severe outbreak of the insect occurred in different parts of Ontario. This outbreak was followed in 1931 by one equally severe and since that time the thrips has continued to cause serious injury. It is looked upon by growers generally as the most important insect pest of gladioli known to-day.

It is still a matter of doubt where this insect pest came from, but its sudden appearance and widespread distribution suggests that it may have been introduced on corms from some other country. It is significant that this species was discovered on gladiolus corms imported from Australia.

Distribution

In Canada, the gladiolus thrips is found in every province. The infestation appears to be centred in Ontario and parts of Quebec, but the insect is present also in the Maritime Provinces, Manitoba, Saskatchewan, Alberta, and British Columbia. In the United States all states are infested by this insect with the exception of Arizona, Arkansas, Kansas, Louisiana, Mississippi, Nebraska, New Mexico, Nevada, Oklahoma, South Dakota, Texas, and Wyoming.

Host Plants

Four years of study* have shown conclusively that the gladiolus is the only true host plant of this insect in Canada. Slight feeding has been noticed on a few other plants, such as carnations, sweet peas, canna lilies, iris, catchfly, chick-

* The writer gratefully acknowledges the assistance rendered by Mr. W. G. Matthewman during the gladiolus thrips investigation.

weed, ribgrass, common plantain, etc., but no serious damage resulted. In the laboratory, the gladiolus thrips was reared on iris, wild flag, carnation, canna lily, and bearded iris. This is of importance as it doubtless means that in the absence of gladioli these plants could possibly serve as hosts to tide the insect over unfavourable conditions.

Description of the Insect

The gladiolus thrips is, in all its stages, a tiny insect, difficult to see without a magnifying glass or microscope. However, with care and in the presence of bright sunlight, even those unfamiliar with this species will be able, with practice, to find any of the stages with the exception of the egg.

The Adult.—The adult is about 1/25 of an inch in length, black, or in some cases, very dark brown. It is supplied with two pairs of membraneous wings which are fringed with delicate hairs. The first pair of wings are pale brown for most of their length but where they join the body are transparent or colourless. When the insect is at rest, the wings are folded longitudinally over the back, in which position these colourless areas appear as two tiny, white spots at about the middle of the body or at the base of the abdomen (see cover illustration).

The Egg.—Due to its extremely small size, it is quite impossible to see the egg of this thrips without the aid of a microscope. The egg is about twice as long as wide, slightly curved and rounded at each end. It resembles a "jelly-bean" in general outline and is pearly-white in colour. The eggs are laid in slits in the tissue of the plant which are first cut by the tiny ovipositor of the insect.

Fig. 2.—Eggs of the gladiolus thrips; greatly magnified (original).

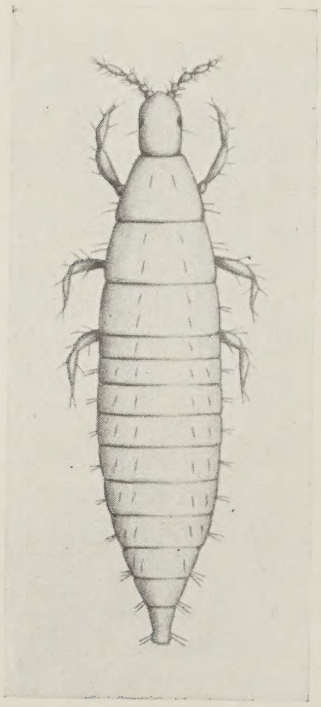

Fig. 1.—Larva of the gladiolus thrips; greatly magnified (original).

The Larva.—Upon hatching from the egg, the larva is extremely small, colourless to pale yellow and possesses two red eyes, one on each side of the head. As it grows, it changes in colour from pale yellow to darker yellow and when full grown assumes an orange shade. It is then about 1/25 of an inch in length and able to move quite rapidly. The larva is wingless in all its stages and, therefore, unable to fly.

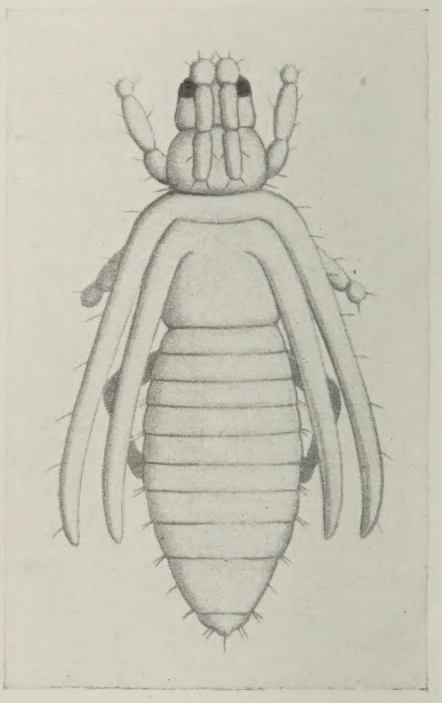

Fig. 3.—Pupa of the gladiolus thrips; greatly magnified (original).

The Pupa.—There is a prepupal and pupal stage in which the insect gradually transforms from the larva to the adult. The pupa closely resembles the full grown larva in size, colour and shape, but is much less active and is

supplied with wing pads, elongate outgrowths which are attached to the thorax or central section of the body and contain the developing wings. The prepupa and pupa seldom move unless disturbed.

Description of Injury

In general, thrips injury can be classified into three types according to the part of the plant attacked, namely, leaf injury, blossom injury, and corm injury. In feeding, the insect pierces the outer surfaces of the tissues with its tiny jaws and then sucks up the liberated plant juices. The injured tissue becomes silvery, or whitish, in appearance, which is typical of the feeding of most species of thrips, including the gladiolus thrips. On the leaves, the tissue, in moderate infestations, becomes streaked with such whitish markings. When the infestation is heavy these coalesce to form large silvery areas, and in very severe cases practically the whole leaf takes on a whitish or bleached appearance.

When the spike is attacked it will be noticed first that the tips of the bracts look bleached and later turn brown. If the thrips are very abundant the blossoms fail to open fully but partially unfold and then wither up and die. When a field is so attacked the bloom looks as though it had been scorched by fire, the tops of the plants turning brown. In moderate infestations the flowers unfold but are defaced by irregular scars or markings which are made by the feeding of the thrips. These take on the typical silvery appearance in dark coloured varieties but when the injured flowers are of a lighter shade this effect is lost. Frequently, the outer edges of the petals wither, become bleached in appearance and shrivel up.

Fig. 4.—Leaves of gladiolus injured by feeding of the gladiolus thrips (after Gibson).

Infested corms if stored under warm conditions are frequently severely injured by the feeding of thrips. The insects live beneath the husk and attack the delicate surface of the corm, which quickly takes on a russetted appearance. In extreme cases the corm changes to dark brown and becomes covered by tiny pale brown scales which can be easily rubbed off. These scales are the dried excrement of the insect. In peeling injured corms it will be noticed, at certain points where the husk is attached to the corm, that narrow areas are found which have escaped injury. In these areas the husk adheres so closely to the tissue that the thrips cannot force their way underneath to feed.

Life-history

The life-history of this insect was studied in the laboratory during the summer of 1932. Rearing was carried on in small salve tins, the insects developing normally in the complete absence of light. Generally, it was found that on the average the gladiolus thrips required fourteen days to reach the adult stage after the eggs had been laid. The rate of development varied somewhat with the temperature, the shortest period for development being twelve days and the longest seventeen days. Between four and five days are spent in the egg stage, five to seven in the larval stage, and four to five days in the pupal stage. The preoviposition period, or the period elapsing between the emergence of the female and the depositing of the first egg, is between one and two days only. The number of generations in the Ottawa district is probably about six, as five generations were reared in the laboratory between the third week of June, when the insects were first found in the field, and the middle of September.

Habits

The gladiolus thrips spends the winter on the corms in storage and in the spring, at time of planting, is taken to the field, thus starting a new infestation. When the corm begins to grow the thrips follows the shoot and at first lives within the leaf sheath, feeding and multiplying. The eggs are freely laid on the tender tissues lining the sheath, and if the infestation is heavy, all stages of the insect are found in that situation. The adults and larvae, in general, remain inside the leaf, but when weather conditions are favourable they migrate to the outside of the leaf, where feeding is continued for short periods of time. It has been found that warm, dull, hazy weather, particularly in the morning, usually induces this movement and while such conditions are present the thrips will remain on the outsides of the leaves. When the sun comes out, however, or if the temperature drops, the insects quickly disappear.

The thrips follow the plant upward as it grows and as soon as the spike swells sufficiently to allow them to work their way under the forming bracts they are to be found in that favoured situation. They feed on the opening buds and when abundant kill the blossom before it has a chance to unfold. If the bloom opens, the adults and larvae cluster beneath the bract and collect in large numbers at the base of the petals, where feeding continues. Eggs are easily and freely laid in the different flower parts and at this season the insects multiply with amazing rapidity. To give an idea of the extreme abundance of these insects on blooming plants, the total number of thrips on one heavily infested gladiolus was counted and 1,640 thrips of all stages (not including eggs) found.

When the flowers die, the thrips once more invade the leaves and stems and for a time feed on the more tender portions of the plant. With the approach of cold weather a large percentage of the population leaves the gladioli and migrates to other plants, and presumably to protected situations for hibernation. The final resting place of the insects has not, as yet, been definitely established, but it is known that many of them simply drop to the ground at the base of the plants. The comparatively few thrips that remain on the gladiolus plants work their way down on to the corms, where a few of them remain underneath the husk until harvest time. Many of the adults and pupae move into the surrounding soil, where they can be found for a short time, but in the end they also disappear. From this it will be seen that of the immense number of thrips present on the plants at blossoming time only a very small percentage remains on the corms to go into storage in the autumn.

Hibernation

Considerable attention has been given to the question of hibernation, or the overwintering habit of the insect. It has been known for quite a long time that thrips are able to live over successfully on corms in storage; to feed and increase and continue their development in quite a normal manner. However, experimental evidence strongly indicates that these insects are not able to with-

Fig. 5.—Typical injury to bloom caused by the gladiolus thrips. Fully opened flower, at left; partially opened bloom, at right (original).

stand the low temperatures of our Canadian winters and that all gladiolus thrips remaining in the field are killed before spring. This question has been studied at Ottawa and Vineland Station, Ont., and Vancouver, B.C., and in every test no thrips could be shown to have survived the winter. It is significant that entomologists studying the point in the United States have come to the conclusion that the gladiolus thrips is not able to come through the winter alive, out of doors, as far north as the Northern States.

Migration

It has been found that there is a distinct movement of thrips into and out of gladiolus beds throughout the growing season. In the summer, when the plants are succulent, this migration is not very marked, the thrips moving in limited numbers from plant to plant in any given patch and to some extent from one bed to the next. In the autumn, however, when the bloom begins to disappear the situation is quite changed, and a brisk movement of thrips out of the infested plots takes place. Whether this migration is induced by the natural drying up of the food source or by the cooler weather of late summer and autumn has not been ascertained. But the fact remains that fully 90 per cent of the adults leave the beds at this time and seek shelter elsewhere. Experimental work has shown that on calm days the thrips are able to fly at least 1,000 feet and, when assisted by the wind, this distance is probably increased very greatly. It will be seen, therefore, that, due to the tendency of the thrips to migrate and their ability to fly a considerable distance, the danger of infection from nearby infested beds is very great.

CONTROL

Control of the gladiolus thrips may be brought about by the treatment of all corms prior to planting. Such a practice kills the hibernating insects, which in many cases have increased enormously in storage, and allows the plants to come up in the field free of this pest. As a result, good crops of uninjured blooms are secured.

Experiments and observations have shown, however, that for this method to give maximum results community action in the treatment of corms in each district should be stressed. It has been found that due to the insects' ability to migrate from garden to garden, treated stock, although clean in the spring, becomes contaminated from nearby infested gladioli. This not only has the effect of introducing the thrips into treated beds but results in disappointment and lack of confidence in the method. Therefore, every effort should be made to induce as many growers as possible in each district to treat their stock before planting.

The time when this work should be done will depend upon circumstances, chiefly storage conditions. If the grower is able to store his corms in a cool cellar where the temperature does not rise above 50 degrees F., treatment should be delayed until spring, and preferably just prior to planting. When napthhalene flakes are used, at least a month should elapse between the time when fumigation is completed and the corms set out in the field. If the place of storage is warm, however, the corms should be allowed to ripen for a period of a month and then treated in the late autumn. This will kill all thrips and prevent them from feeding and multiplying throughout the winter months, which is not only directly injurious to the corms but results in an enormous increase in the thrips population.

Great care must be exercised to safeguard the treated corms from reinfestation. Due to their ability to fly, adult thrips are to be found distributed over flats, boxes or bags in which the corms are stored, as well as on the walls and ceiling of the storage cellar. Accordingly, it is most unwise to treat the corms

and then place them back in the old place of storage where they will become reinfested by the thrips which have remained there. Corms after treatment, if they are to be stored, should be placed only in new containers and in rooms known to be free from thrips. This difficulty can be obviated by delaying treatment until the spring and then planting the corms immediately.

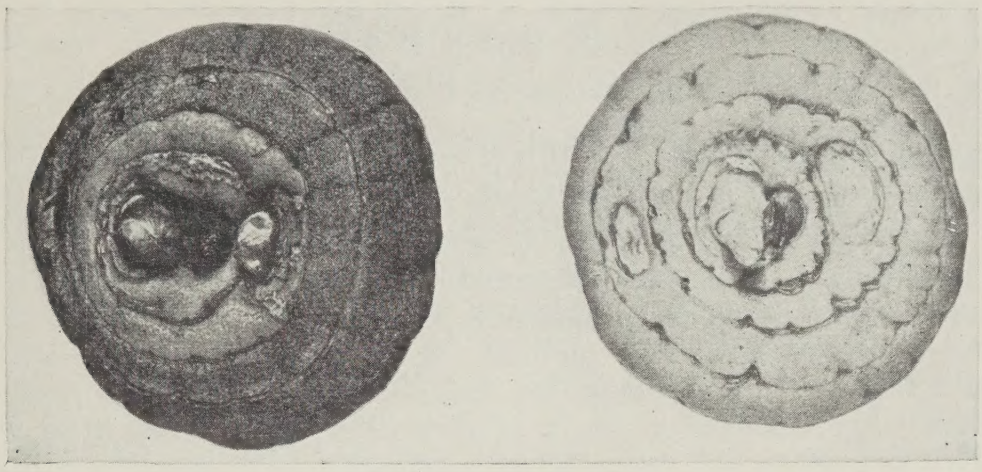

FIG. 6.—Gladiolus corm injured by feeding of the gladiolus thrips, at left; uninjured corm, at right (original).

TREATMENT OF CORMS

There are three treatments which, through effective use, have become the widely accepted methods for ridding corms of thrips, namely, (1) fumigation with naphthalene flakes, (2) dipping in corrosive sublimate and (3) immersion in hot water. These methods are discussed in detail below.

(1) *Naphthalene Flakes.**—Fumigation with naphthalene flakes has become very popular among growers since the method is recognized as being simple, safe and effective. The flakes are used at the rate of one ounce to each 100, average-sized corms. The corms after ripening for at least a month are placed in paper bags, cardboard or wooden boxes and the correct amount of naphthalene flakes sprinkled among them. The containers are then closed for a period of four weeks and the process of fumigation carried out at a temperature of approximately 70° F. This time can be doubled without injury to the corms. When fumigation has been completed, the corms are removed from the containers and any adhering flakes shaken off. Corms planted immediately after fumigation are very slow in starting growth. It has been found that this temporary setback can be avoided if the corms are allowed to air thoroughly for a month before they are placed in the ground. Fumigation should never be carried out in air-tight containers as sweating and growth of the corms are liable to result.

Some growers appear to have difficulty in securing naphthalene flakes and are persuaded by their druggists or seedsmen to substitute camphor, the claim being that camphor flakes are just as effective as naphthalene. This is not a fact, however, and anyone using this method is strongly advised to insist on being supplied with naphthalene flakes.

(2) *Corrosive Sublimate* (Mercury bichloride).—This material is diluted at the rate of one ounce to six gallons of water and used in the form of a dip. It can be purchased at most seed houses and drug stores and usually comes in the form of a white powder or in tablets. If tablets are used, growers should remember that only a small percentage of each is pure corrosive sublimate; the

* This method was first advocated by Messrs. Weigel, Smith and Richardson of the United States Bureau of Entomology and Plant Quarantine, Washington, D.C.

exact proportion will be given on the container, and unless allowance is made for this fact when preparing the bath the solution produced will be under strength and only a percentage of the thrips killed. This insecticide dissolves very slowly in cold water and the process can be hastened considerably if a small amount of hot water is first used and the liquid then diluted with cold water to the correct strength. Corrosive sublimate should be dissolved only in wooden, glass or earthenware vessels as it quickly loses its value if it comes in contact with metals. It is deadly poison if taken internally and the greatest care must be exercised in its use. The bath is used at room temperature, or at about 70° F.

Corms should be soaked for three hours if peeled, or for twenty hours if unpeeled. Growers are advised to treat their corms in the spring, just prior to planting, as this will save the trouble of drying them before restoring.

(3) *Hot Water.*—The chief advantages of the hot water method are cheapness, speed of application, availability of materials and the fact that peeling of the corms is unnecessary. This method should appeal particularly to the small grower with few corms to treat as the operation can be carried on conveniently with ordinary home utensils. It is recommended that it be used only in the spring, after the corms are fully ripened, and that planting follow immediately. This will save the necessity of drying the corms.

In treating corms with hot water they should be immersed for 10 minutes in a bath at a temperature of 120 degrees F. It will be found much easier to keep the temperature up to the correct point if an abundance of water is used and if the treatment is carried out in a warm room. It also helps greatly to have the vessel suitably covered. The temperature of the bath can be kept at the correct point by pouring in additional quantities of hot water from time to time during treatment. This should be added carefully and only while the water in the bath is being stirred. Care must be taken not to allow the temperature at any time during treatment to go above 120 degrees F., as injury to the corms may follow. A thermometer of good commercial grade should be suspended in the water during treatment and should be watched continuously during the process.

Summer Treatment

During the early part of the growing season, the gladioli should be carefully watched to learn if thrips are present. Should they be found, the plants must be sprayed weekly until blooming time with a mixture composed of one tablespoonful of Paris green, two pounds of brown sugar and three gallons of water. It has been found a good practice to commence spraying when the plants are six inches in height and continue at weekly intervals until the blossoms appear. Best results will be secured if this spray is applied on a warm, calm day. Experimental work carried on recently has shown that practically as good results will be secured if five applications of the spray are concentrated in the fortnight immediately preceding the blossoming period, or the time when the first blooms start to unfold, this treatment taking the place of the weekly sprays mentioned above. In spraying, use plenty of material and stir the solution frequently to prevent the Paris green from settling to the bottom of the container. Considerable pressure must be used as this breaks the spray up into fine mist, enabling it to spread and adhere better.

Many growers, and more particularly the smaller ones, are in the habit when planting of mixing their varieties in such a way that the early and late blooming varieties stand indiscriminately in the plot. This is an unwise practice when using a control such as the above which calls for continuous spraying until the time of blossoming, yet not after. The Paris green-brown sugar spray should not be applied to *the blooms* as it covers them with a sticky residue. However, to be effective, spraying must be continued right up until the time the

flowers open. In stands of mixed varieties efficient treatment is, therefore, next to impossible, for once the earliest blooms appear spraying must cease even though the later varieties do not blossom for a month or more. Growers are, therefore, advised to group the various varieties either separately or at least according to their different flowering dates. This will make for much more effective control and will simplify spraying operations tremendously.

Care of the Corms at Harvest

Care of the corms at harvest is very important in order to safeguard them from becoming infested by thrips dropping or flying from the tops. The tops should be cut as near to the corm as can be done with safety, thus discarding most of the stem and leaves, where the thrips are customarily found. Care should be exercised in removing the tops, so as not to shake off any of the thrips onto the corms lying on the ground. Some growers cut off the tops by means of large shears while the corms are still standing in the ground and then remove the stems and leaves before the corms are dug. Another method is to make use of two wheel-barrows, one on either side of the row, throwing the corms into one and the tops into the other, as soon as they are dug and cut. Both of these methods have given excellent results.

Under no circumstances should the corms be allowed to dry in the gladiolus bed, as this at once exposes them to infestation by the adults which are flying about at that time. As soon as the corms are dug they should be topped and immediately removed to some other situation where there will be no danger of the thrips reaching them.

In previous recommendations, before the life-history of the gladiolus thrips was worked out in detail, the destruction of the tops in the autumn, either by burning or burying was advised. Since all indications point to the fact that the gladiolus thrips is not able to hibernate successfully out of doors in Canada, this step now seems unnecessary. However, the composting of all stems and leaves as soon as the corms are harvested is recommended, not only to remove the danger of thrips migration at that season of the year but to do away with even the remote chance of thrips coming through the winter on such debris.

Winter Storage

The importance of storing the corms at a low temperature during the winter months cannot be emphasized too strongly. Thrips activity ceases at a temperature of 40 degrees F. or lower, and in cases where corms are stored at this point no injury will result and no increase among the insects take place. Experiments recently carried on in the United States* have proved that all stages of the gladiolus thrips are killed by storing the infested corms at a constant temperature of 36 degrees F. for two months, or of 40 degrees F. for three months.

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* R. H. Nelson, Bureau of Entomology and Plant Quarantine, Washington, D.C.,—Paper read before American Association of Economic Entomologists, Pittsburg, Dec. 29, 1934.